838

Class B Modulator, R-F Power Amplifier

RCA-838 is a high-mu, three-electrode transmitting tube for use as a zero-bias class B audio-frequency power amplifier. The grid is designed so that the amplification factor of the tube varies with the amplitude of the input signal. This feature facilitates the design of class B amplifiers to give high output with low distortion. In class B audio service, two tubes of this type are capable of giving an output of 260 watts with less than 5% distortion. The 838 may also be used as a radio-frequency power amplifier or oscillator at maximum ratings for frequencies as high as 30 Mc. The maximum plate dissipation for class B and class C telegraph services is 100 watts.

CHARACTERISTICS and RATINGS

FILAMENT VOLTAGE (A.C. or D.C.)	10.0	Volts
FILAMENT CURRENT	3.25	Amperes
DIRECT INTERELECTRODE CAPACITANCES:		
Grid-Plate	8	μμf
Grid-Filament	6.5	μμf
Plate-Filament	5	μμf
BULB (For dimensions, see page 4)	T-18	
BASE (For socket connections, see page 4)	Jumbo 4-Large Pin	

MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS

As A-F Power Amplifier and Modulator - Class B

D-C PLATE VOLTAGE	1250 max.	Volts
MAX.-SIGNAL D-C PLATE CURRENT *	175 max.	Milliamperes
MAX.-SIGNAL PLATE INPUT *	220 max.	Watts
PLATE DISSIPATION *	100 max.	Watts

TYPICAL OPERATION:

Unless otherwise specified, values are for 2 tubes

D-C Plate Voltage	1000	1250	Volts
D-C Grid Voltage oo	0	0	Volts
Peak A-F Grid-to-Grid Voltage	200	200	Volts
Zero-Sig. D-C Plate Current	106	148	Milliamperes
Max.-Sig. D-C Plate Current	320	320	Milliamperes
Load Resistance (Per tube)	1725	2250	Ohms
Effective Load Resistance (Plate-to-plate)	6900	9000	Ohms
Max.-Sig. Driving Power (Approx.)	7	7.5	Watts
Max.-Sig. Power Output (Approx.) #	200	260	Watts

As R-F Power Amplifier - Class B Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

D-C PLATE VOLTAGE	1250 max.		Volts
D-C PLATE CURRENT	150 max.		Milliamperes
PLATE INPUT	150 max.		Watts
PLATE DISSIPATION	100 max.		Watts
TYPICAL OPERATION:			
D-C Plate Voltage	1000	1250	Volts
D-C Grid Voltage oo	0	0	Volts
Peak R-F Grid Voltage	70	60	Volts
D-C Plate Current	130	106	Milliamperes
D-C Grid Current (Approx.) **	15	15	Milliamperes
Driving Power (Approx.) ** o	8	6	Watts
Power Output (Approx.)	40	42.5	Watts

As Plate-Modulated R-F Power Amplifier - Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

D-C PLATE VOLTAGE	1000 max.		Volts
D-C GRID VOLTAGE	-400 max.		Volts
D-C PLATE CURRENT	175 max.		Milliamperes
D-C GRID CURRENT	70 max.		Milliamperes
PLATE INPUT	175 max.		Watts
PLATE DISSIPATION	67 max.		Watts
TYPICAL OPERATION:			
D-C Plate Voltage	750	1000	Volts
D-C Grid Voltage:			

*, **, #, o, oo: See end of tabulation.

Copyright, 1935
RCA Manufacturing Co., Inc.

From fixed supply of	-100	-135		Volts
From grid resistor of	1700	2300		Ohms
Peak R-F Grid Voltage	220	255		Volts
D-C Plate Current	150	150		Milliamperes
D-C Grid Current (Approx.) **	60	60		Milliamperes
Driving Power (Approx.) **	14	16		Watts
Power Output (Approx.)	65	100		Watts

As R-F Power Amplifier and Oscillator - Class C Telegraphy

Key-down conditions per tube without modulation ##

D-C PLATE VOLTAGE			1250 max.	Volts
D-C GRID VOLTAGE			-400 max.	Volts
D-C PLATE CURRENT			175 max.	Milliamperes
D-C GRID CURRENT			70 max.	Milliamperes
PLATE INPUT			220 max.	Watts
PLATE DISSIPATION			100 max.	Watts
TYPICAL OPERATION:				
D-C Plate Voltage	750	1000	1250	Volts
D-C Grid Voltage:				
From fixed supply of	-80	-85	-90	Volts
From cathode resistor of	445	470	500	Ohms
From grid resistor of	2700	2800	3000	Ohms
Peak R-F Grid Voltage	190	195	200	Volts
D-C Plate Current	150	150	150	Milliamperes
D-C Grid Current (Approx.) **	30	30	30	Milliamperes
Driving Power (Approx.) **	6	6	6	Watts
Power Output (Approx.)	65	100	130	Watts

*
** Averaged over any audio-frequency cycle of sine-wave form. Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.

\# Approximately 4% harmonic distortion.

\#\# Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

o At crest of audio-frequency cycle with modulation factor of 1.0.

oo Grid voltages are given for either a-c or d-c filament operation. When a.c. is used, the circuit returns are made to the mid-point of the filament circuit. When d.c. is used, the returns are made to the negative filament terminal.

INSTALLATION

The *base* of the 838 fits the standard transmitting 4-contact socket such as the RCA type UT-541A which should be installed to hold the tube in a vertical position, base down. If it is necessary to mount the tube in a horizontal position, the tube should be mounted with the plate in a vertical plane (on edge).

The *bulb* becomes very hot during continuous operation so that free circulation of air around the tube should be provided. The installation of all wires and connections should be made so that they will not be close to or touch the bulb in order to avoid puncture of the glass due to peak voltage effects.

The *filament* is of the thoriated-tungsten type. The filament voltage should not vary more than plus or minus 5% from the rated value; otherwise, a loss of filament emission may result. When the apparatus in which the tube is used is idle for periods not exceeding two hours, the filament should be maintained at its rated voltage during the "standbys".

The *plate* of the 838 shows a barely perceptible red color at the maximum plate-dissipation rating for each service.

Overheating of the 838 by severe overload may decrease filament emission. The activity of the filament can sometimes be restored by operating the filament at rated voltage for ten minutes or more with no voltage on the plate or grid. This process may be accelerated by raising the filament voltage to 12 volts (not higher) for a few minutes. The positive high-voltage supply lead of the 838 should be provided with a protective device such as a high-voltage fuse to prevent the tube from drawing excessive plate current. This device should instantly remove the plate voltage when the d-c plate current reaches a value 50% greater than normal.

In order that the maximum ratings given under CHARACTERISTICS will not be exceeded, changes in plate and filament voltages due to line-voltage fluctuation, load variation, and manufacturing variation of the associated apparatus, must be determined. An average value of plate and filament voltage should then be chosen so that under the usual voltage variations the maximum rated voltage will not be exceeded.

When a new circuit is tried or when adjustments are made, it is advisable to reduce the plate voltage. This may be done conveniently by connecting a resistance of about 3000 ohms in series with the high-voltage plate lead during the adjustments.

The rated plate voltage of this tube is high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially when the exposed circuit parts are at the high d-c plate potential.

APPLICATION

In *class B modulator or audio-frequency service,* two 838's are used in a balanced circuit, each tube amplifying half the time. The output transformer should be designed so that the resistance load presented by the modulated class C amplifier is reflected as the recommended plate-to-plate load. The input transformer can be designed for operation under approximately uniform loading conditions to give excellent frequency response. Due to the low grid-bias characteristic of the 838, grid current is drawn on any input signal. Grid bias should be obtained from a battery or other d-c source of good regulation. It should not be obtained from a high-resistance supply such as a grid leak or cathode resistor.

In special cases where it is desirable to keep the audio-frequency distortion of the class B a-f amplifier or modulator to a value lower than 4%, the use of a small amount of grid-bias voltage is advantageous. Typical operating conditions are approximately the same as those for zero-bias operation. With a plate-supply voltage of 1250 volts, the exceptions are: grid-bias voltage, -15 volts; peak a-f grid-to-grid voltage, 210 volts; and zero-signal d-c plate current, 50 milliamperes (2 tubes).

In *class B r-f service,* the 838 is supplied with unmodulated d-c voltage. The grid is excited by r-f voltage modulated at audio frequency in one of the preceding stages. The plate dissipation is greatest when the carrier is unmodulated. Grid bias may be obtained from a battery or from a cathode resistor, suitably by-passed for audio and radio frequencies.

In *plate-modulated class C r-f service,* the 838 may be supplied with grid bias from a grid leak, or from a suitable combination of either grid leak and fixed supply, or grid leak and cathode resistor. The cathode resistor should be suitably by-passed for audio and radio frequencies. The combination-bias method of grid leak and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also minimizes distortion effects by means of bias-supply compensation. Grid-bias voltage is not critical so that correct adjustment may be obtained with values differing widely from those indicated for this service.

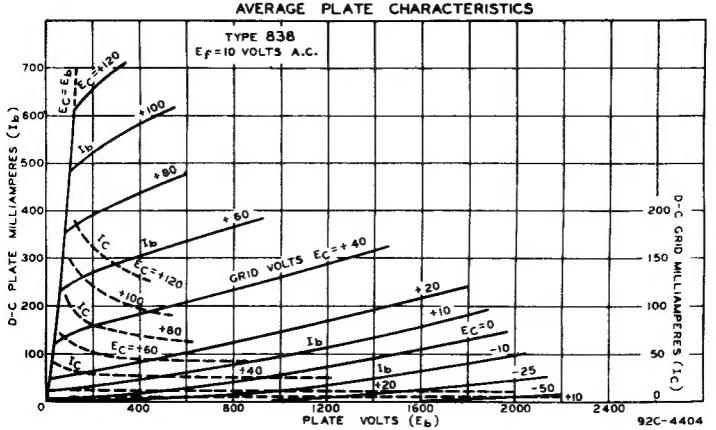
In *class C r-f telegraph service,* RCA-838 may be supplied with grid bias by any convenient method. The grid-leak method is particularly useful, for even when the grid excitation is accidentally removed, the probability of tube damage is small because of low zero-bias plate current.

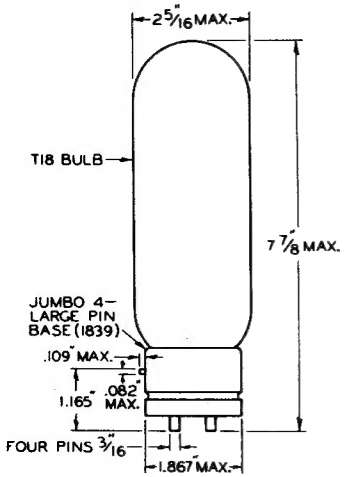
RCA-838 may be operated at maximum ratings in all classes of service at frequencies as high as 30 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised (other maximum ratings are the same as shown under CHARACTERISTICS). The tabulation below shows the highest percentage of maximum plate voltage and power input that can be used up to 120 Mc. Special attention should be given to adequate ventilation at these frequencies.

FREQUENCY	30	50	120	Megacycles
PERCENTAGE of MAX. RATED PLATE VOLTAGE and PLATE INPUT	100 *max.*	75 *max.*	50 *max.*	Per Cent

If more radio-frequency power output is required than can be obtained from a single 838, the push-pull or the parallel connection may be used. For example, two tubes connected in push-pull or in parallel will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage; the push-pull connection requires twice the r-f excitation necessary to drive a single tube. With either connection the driving power required is approximately twice that for single-tube operation while the grid bias is the same as that for a single tube. The push-pull arrangement has the advantage of simplifying the balancing of high-frequency circuits to ground and of cancelling the even-order harmonics from the output. Parasitic suppressors connected in series with each grid lead as close to the tube socket as possible will often prevent parasitic oscillations in push-pull and in parallel circuits. The suppressor consists of a non-inductive resistor of 10 to 100 ohms connected in parallel across a suitable r-f choke. It is preferable to provide for separate grid-bias or grid-excitation adjustment in order to balance the grid and plate current.

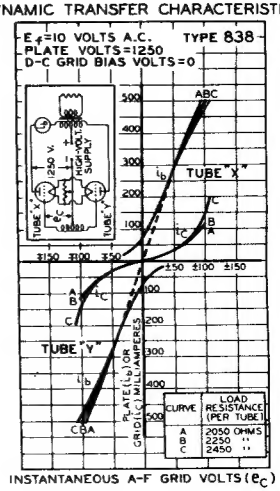
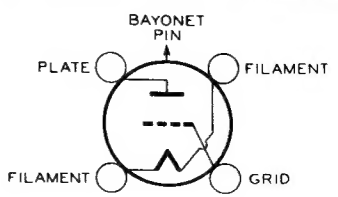
AVERAGE PLATE CHARACTERISTICS





925-4313

DYNAMIC TRANSFER CHARACTERISTICS



Top View of Socket Connections